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# NETWORK ACCESSIBLE MULTI-TERABYTE ARCHIVE

NSSDC CONFERENCE  
GODDARD SPACE FLIGHT CENTER  
JULY 24, 1991

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Metrum Information Storage

## ROTARY STORAGE SYSTEM (RSS)

- T-120 Super-VHS media with 10.4 GB per cartridge
- Very Large Data Store (VLDS) tape drives
  - Sustained 1.0 MB/S with Read-After-Write
  - 1E-13 Bit Error Rate w/ error mgt software
  - 45 sec average file access time
- Robots with on-line capacity to 6.2 TB
- Bar code reader
- Data management computer
  - Data referenced by file name
  - Files organized by hierarchical directories
  - File and directory access protections
- Network accessible

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## METRUM INFORMATION STORAGE SYSTEMS BASED ON STANDARDS

### MEDIA

- World-wide VHS media standard
- T-120 half-inch tape cartridge
- Billions of cartridges sold

### TAPE DRIVE

- SMPTE format VHS transport
- Millions of transports sold
- Commercial grade

### ROBOT

- Commercial broadcast industry

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# METRUM INFORMATION STORAGE STANDARDS - concluded

## BAR CODE READER

- Standard formats

## INTELLIGENT DATA MANAGER (COMPUTER)

- UNIX based
- POSIX compliance

## NETWORK CONNECTIVITY

- Ethernet TCP/IP and DECNET
- HYPERCHANNEL
- FDDI
- GOSIP
- NFS

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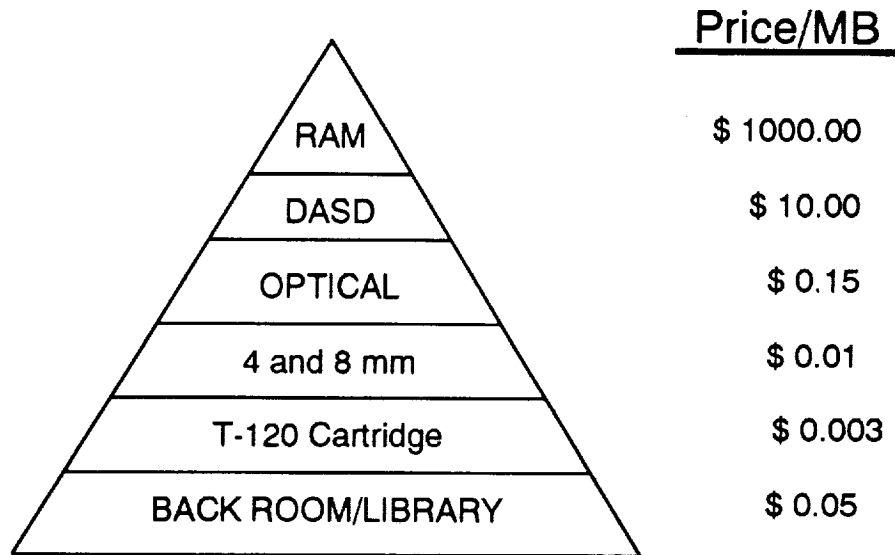
# MANAGED DATA STORAGE GOALS

- Maximize data per unit volume, balanced by
  - Cost/MB of Media
  - Cost/MB of Technology
  - Required data rates
- Optimize media access
  - Unattended media access
  - Media ID verification
  - Speed of loading
- Provide ease of access to the data
  - Easily identify data to be stored/retrieved
  - Concurrent access from multiple computer systems

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# STORAGE HIERARCHY

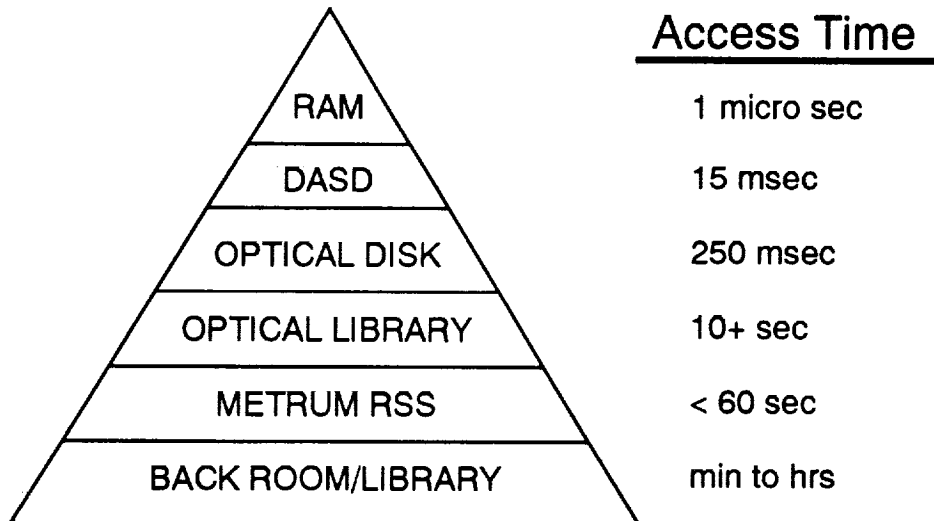
## TYPICAL MEDIA PRICE/MB



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# STORAGE HIERARCHY

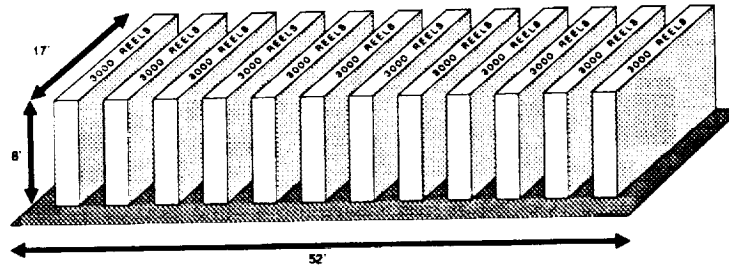
## TYPICAL ACCESS TIMES



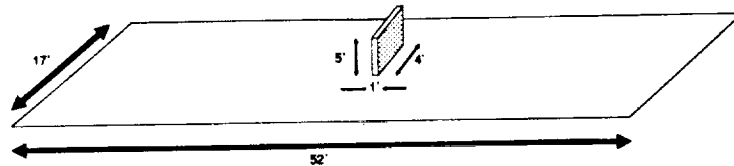
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# VOLUME COMPARISON

## 6 Terabytes



9-Track, 6250 bpi  
2400 Ft, 170 MB  
35,000+ Reels  
850+ Sq Ft



T-120 Cartridge  
10.4 GB/Cartridge  
600 Cartridges  
4 Sq Ft

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# VOLUME COMPARISON

One T-120 Cartridge (10.4 GB) Equals

- 61 nine-track reels at 2400 ft/reel, 6250 bpi and 170 MB/reel
- 50 cartridges of 3480 at 200 MB/cartridge

One Cubic Foot of Storage Can Contain

- 12-15 nine-track reels
- 60 cartridges of 3480 (equals 70 nine-track reels)
- 30 T-120 cartridges (equals 1,800 nine-track reels)

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## RSS FEATURES

- 6.2 TB in < 20 sq ft
- System cost < 8.5 cents per MB  
(RSS-600, 2 drives, 600 cartridges = \$530,000)
- Media cost < 0.3 cents per MB  
(\$30/cleaned and certified cartridge)
- Unattended operation
- Network accessibility
- Read-After-Write reliability (1E-13 BER)

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## RSS DATA ACCESS

- Archive system accessed via network
- Access authorization screening (UserID & Password)
- Entire archive looks like a single huge disk
  - Data accessed by file name
  - Multi-level hierarchical directories
  - Selective directory & file protection
- File access is random (cartridge rewind not required)
- Avg file access is 45 sec for loaded cartridge
- Cartridge load in < 8 seconds
- Intelligent queue management

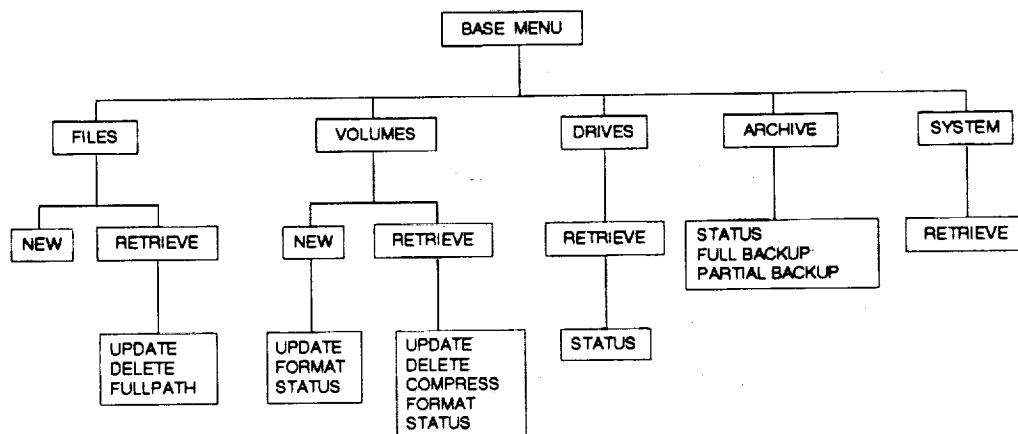
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# RSS DATA MANAGEMENT

- Database Management System
  - 90 million files
  - 65,000 cartridges
  - Maintains system performance log
  - Comprehensive report generator
- Monitors system events
  - Errors are categorized by severity
  - Multiple notification targets, including e-mail
  - Incorporates recovery algorithms
- User data can be directed to specific cartridge(s)
- Admin functions available at console & via network

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# RSS ADMINISTRATION MENU MAP



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# RSS ADMINISTRATION BASE MENU

AMASS Administration

Version: AMASS/2.4

Files(1)	Volumes(2)	Drives(3)	Archive(4)	System(5)
Wipe(0)	Help(PF2)	End(PF3)	Quit(PF4)>	

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# RSS ADMINISTRATION FORMS INTERFACE

## FILES / RETRIEVE MENU

AMASS Administration

Name:	1990_wp_files	Record:	32
User:	100	Parent's Record:	15
Group:	101	Volume:	
Mode:	rwX-----	Volume Group:	3
Type:	Directory	Starting Block:	
Size:		Bad Blocks:	
Archived:	01-13-91 13:18:22	Nr of Errors:	
Accessed:	01-13-91 13:18:22		

3 of 13

Files/Retrieve

Update

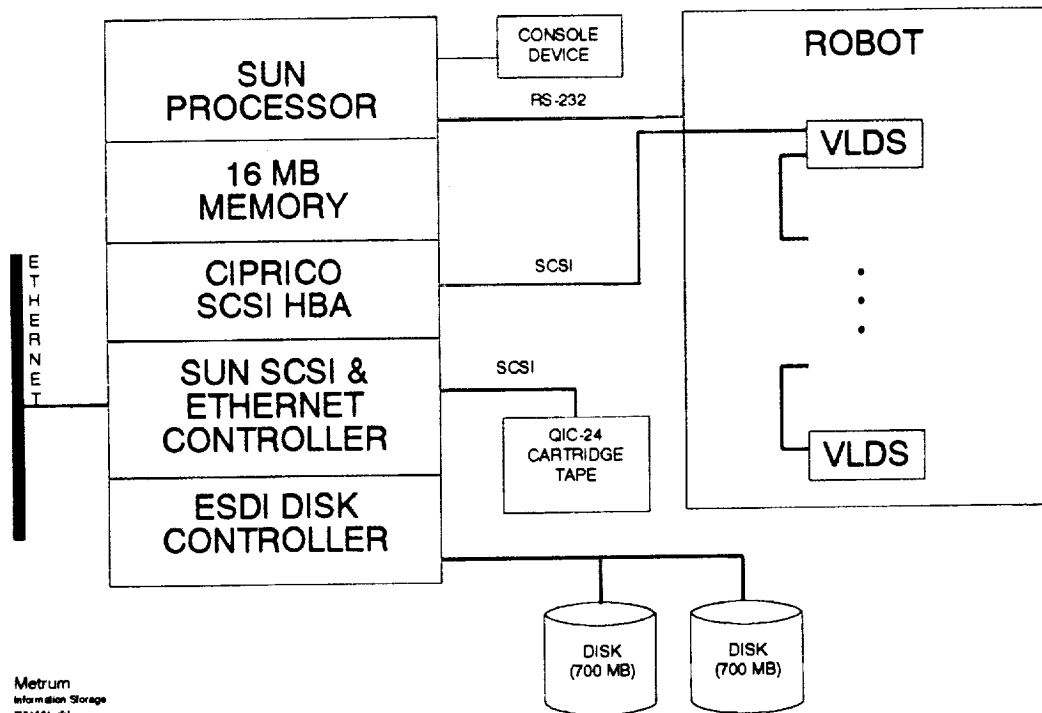
Delete

Fullpath

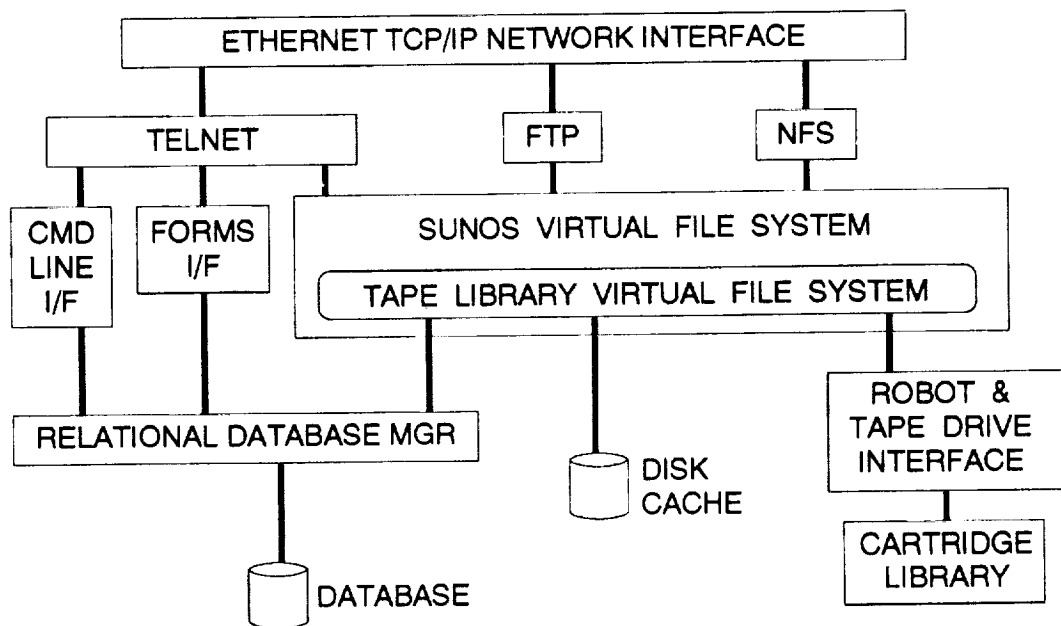
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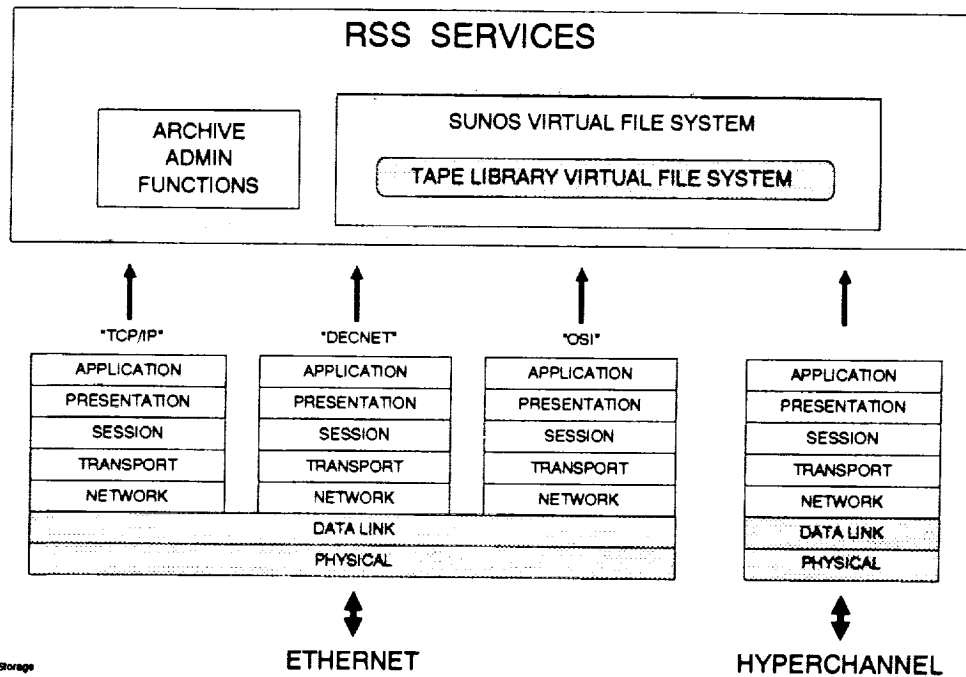
# RSS HARDWARE ARCHITECTURE



# RSS SOFTWARE ARCHITECTURE

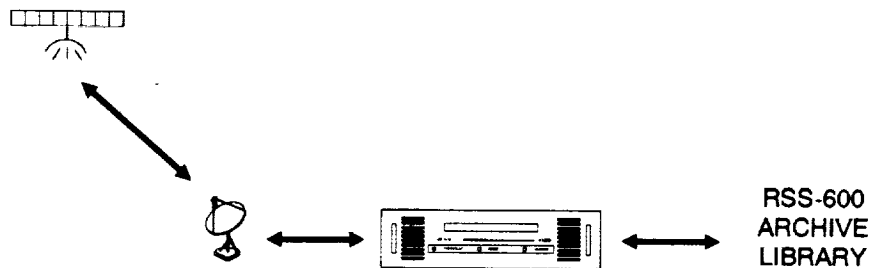


# RSS SUPPORTS MULTIPLE CONCURRENT PROTOCOLS



## DATA SOURCES

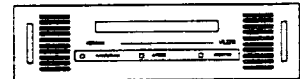
- Data acquisition systems
- Data transcription systems
- Local computer file systems
- Remote computer file systems



## TAPE DRIVE CONFIGURATIONS READ-AFTER-WRITE VLDS

- 1 MB/S fixed rate, read while write
- 1E-13 BER with error management software
- 10.4 GB cartridge capacity (\$.002/MB media cost)
- 6.2 TB in RSS-600 (\$.085/MB system cost)

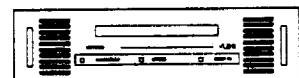
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## TAPE DRIVE CONFIGURATIONS VLDS FAMILY

- 1 - 4 MB/S fixed rate
- 1E-8 to 1E-10 BER, config dependent
- Variety of interfaces
- Up to 10.4 GB per cartridge (\$.003/MB media cost)
- Up to 6.2 TB in RSS-600 (\$.085/MB system cost)

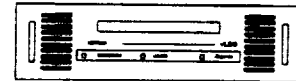
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## TAPE DRIVE CONFIGURATIONS BUFFERED VLDS

- 0 - 4 MB/S variable rate
- 4 MB/S maximum sustained rate
- 20 MB/S burst (16 MB buffer)
- Variety of interfaces
- 1E-8 Bit Error Rate
- 10.4 GB cartridge capacity (\$0.003/MB media cost)
- 6.2 TB RSS-600 capacity (\$0.09/MB system cost)

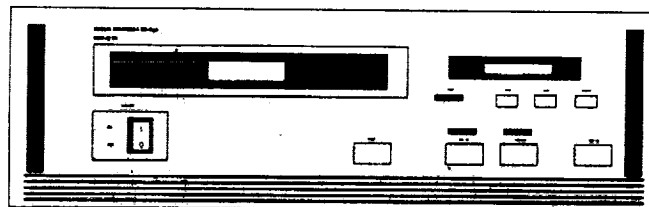
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## TAPE DRIVE CONFIGURATIONS RSP-2150

- 0 - 2 MB/S variable rate
- 2 MB/S maximum sustained rate
- 4 MB/S burst rate (8 MB buffer)
- SCSI or PERTEC interface
- 1E-14 bit error rate (auto re-read/write)
- Up to 14.5 GB per cartridge (\$0.001/MB media cost)
- Up to 8.7 TB in RSS-600 (\$0.06/MB system cost)

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## OPTICAL TAPE DRIVE HD-1000

- 0 - 3 MB/S variable (3 MB/S sustained)
- SCSI interface
- 1E-12 bit error rate (auto re-read/write)
- 1 TB per reel (\$.005/MB media cost)
- 28 sec avg access time (60 sec end-to-end)
- \$250K drive cost
- Future adaptation to RSS-600 chassis

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## RSS ARCHIVE ARCHITECTURE SUMMARY

- UNIX-based operating system
- Standard network protocols
- User-directed archiving
- Supports automatic archiving
- Managed data
- Fast, easy access

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